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New Varieties of Oats From Bond Crosses Resistant to Victoria Blight¹

By

T. R. STANTON

Senior agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration

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THE virulent and destructive Victorian blight of oats caused by the fungus *Helminthosporium victoriae* Meehan and Murphy, which was first observed in 1944 (10, 11),² occurred in epidemic proportions in 1946 and 1947 in certain sections of the United States. It attacked only the comparatively new and widely grown rust- and smut-resistant varieties of oats, such as Boone, Cedar, Tama, and Vicland, which had been developed from crosses with the Victoria variety. This new blight has greatly reemphasized the importance of disease as a limiting factor in oat production and the need for additional varieties resistant to this disease. Fortunately, the development of improved varieties of oats from Bond crosses with better resistance to crown and stem rusts, more satisfactory agronomic characters, and above all with resistance to the Victoria blight was well under way in 1944. Several of these new strains, including the already well-known Clinton, have been increased, named, and distributed to replace the susceptible varieties derived from Victoria-Richland crosses. This second group of new varieties should place oats on an even higher economic status as a rotation and feed crop in American agriculture than that established

¹ Varieties developed cooperatively by the Iowa, Indiana, Illinois, Kansas, Nebraska, Minnesota, Michigan, New York, Florida, and Louisiana Agricultural Experiment Stations and the United States Department of Agriculture.

In most previous publications the common name "helminthosporium blight" has been used for the disease caused by *Helminthosporium victoriae* Meehan and Murphy. As leaf and glume blotch of oats (caused by *Helminthosporium avenae* Eidam) is also a helminthosporium blight, the simpler and less confusing term "Victoria blight" has been used in this circular.

² Italic numbers in parentheses refer to Literature Cited, p. 6.

by the culture of the previous group of improved Victoria-Richland varieties (17).

The Victoria blight organism probably was present in North America before 1944 but was not detected on oats, because all the older varieties grown were resistant to the disease (13). The replacement of the susceptible varieties should greatly reduce the extent of this disease organism on oats. It probably will still be present, however, on the roots of certain other grasses.

BETTER VARIETIES OBTAINED FROM CROSSES WITH BOND

The Bond variety was introduced from Australia by the United States Department of Agriculture in 1929. By the end of 1947 a total of 13 named varieties of spring oats had been developed from Bond crosses. Those now available for growing or for planned early distribution are Clinton, Benton, Cherokee, Bonham, Advance, Shelby, Eaton, Mohawk, Bonda, Mindo, Andrew, Zephyr, and Nemaha (1, 5, 6, 7, 8, 9, 12, 14, 18, 19). Still other new strains originating from Bond crosses are in process of development, especially hardier and better adapted varieties for fall seeding in the South. Camellia (16, 20) and Florida 167 (15) are the only two varieties resistant to the Victoria blight originating from Bond crosses that are available for the South, and the adaptation of these is extremely limited.

In addition to their resistance to the Victoria blight, the new spring varieties named above are resistant to all races of crown (leaf) rust except races 45, 57, and possibly other similar races, to all the more common races of stem rust, and to many of the northern races of the oat smuts. Their disease resistance make them superior, except for smut reaction, to the varieties derived from Victoria-Richland crosses. Furthermore, they are superior in yield and quality and have stiffer straw than any variety of oats yet distributed in the United States. The stiff straw makes them highly desirable for combine harvesting, which method is gradually replacing the old method of binder harvesting in nearly all sections (fig. 1). Other varieties derived from Bond crosses described in this circular are likewise well adapted for this type of harvesting.

Two southern varieties derived from Bond crosses—Camellia and Florida 167—lack resistance to stem rust but are resistant to many races of crown rust and smut and to Victoria blight. These two varieties, however, are not resistant to leaf and glume blotch (caused by *Helminthosporium avenae*), the incidence of which has increased markedly on varieties derived from Bond crosses in the lower South, especially in northern Florida, during the past 2 years. Neither Camellia nor Florida 167 is hardy enough even for the northern part of the red oat area of the winter oat belt of the South. New and as yet unnamed strains from crosses of Bond on Fulghum, Red Rust-proof, and other varieties resistant to *H. victoriae* are in process of development. These are about as winter resistant as the Red Rust-proof strains, such as Appller, Bancroft, Nortex, and Ferguson 922, and therefore should offer new early red oats with resistance to Victoria blight for the main Cotton Belt. Varieties with Bond germ plasm suitable for the northern part of the winter oat belt have not

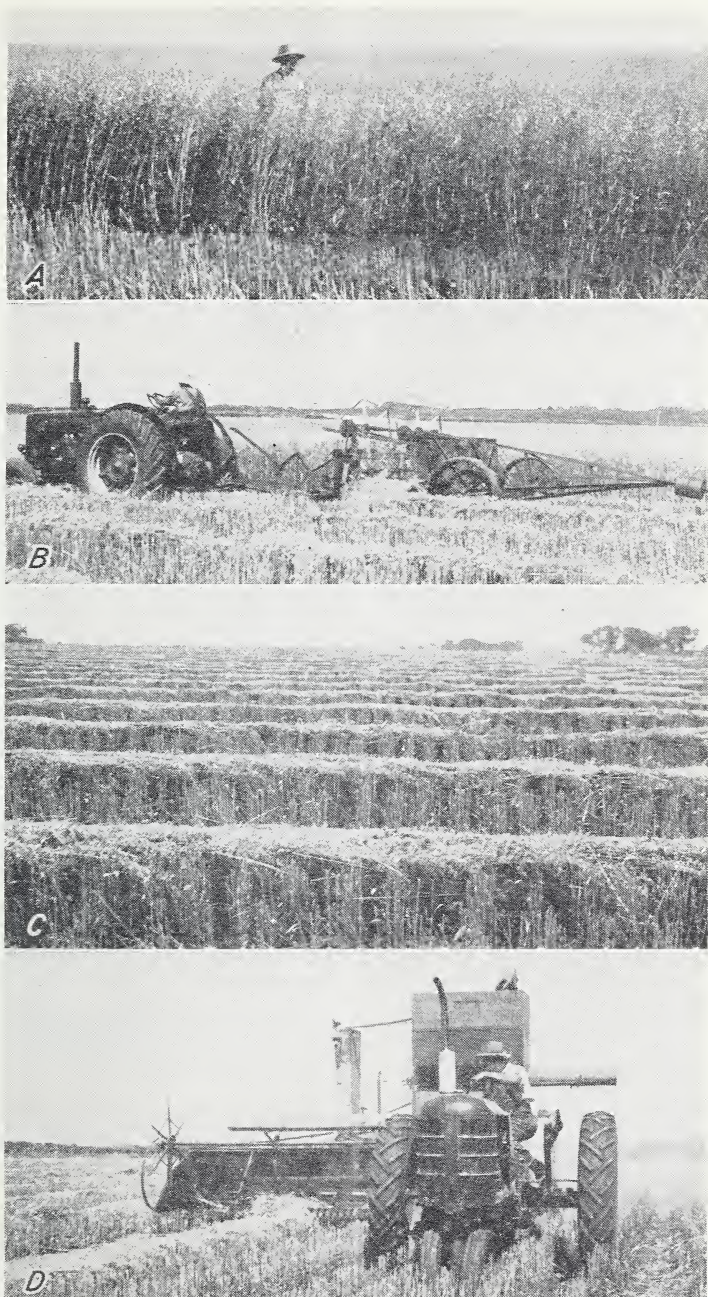


FIGURE 1.—Harvesting Clinton oats in Iowa: A, Field ready for harvesting; B, windrowing oats; C, windrowed field (the stiff straw holds up oats for drying); and D, picking up and threshing oats with a combine harvester equipped with special pick-up attachment.

yet been developed. Difficulty has been encountered in combining satisfactory disease resistance with winter hardiness in Bond-cross derivatives. Nevertheless, progress is being made and satisfactory varieties should be available later.

For yield and other data on the new varieties discussed above, see recent reports by Coffman (2, 3, 4). The origin and pertinent characteristics of the oat varieties derived from crosses with the Bond variety are listed in table 1.

ORIGIN OF CERTAIN PARENT VARIETIES

The origin of certain of the parental varieties used in the development of the varieties listed in table 1 is given below.

Bond oats originated in Australia from a cross between Golden Rain, a midseason to late, yellow, and highly productive Swedish oat, and a sport or offtype of the Red Algerian variety introduced into Australia from Algeria. Golden Rain, in common with other Swedish varieties, is susceptible to all common diseases of oats, but the Red Algerian parent apparently carried genes for high resistance to most races of crown rust and to some races of oat smut. This may account for the high resistance of Bond to crown rust. Furthermore, genes for the fairly stiff straw of Golden Rain must have been combined with complementary genes for stiff straw carried by the Red Algerian sport to produce the exceptionally stiff straw of Bond.

The Iowa D67 and Iowa D69 strains were developed from crosses between Richland and Green Russian in cooperative oat breeding investigations of the Iowa Agricultural Experiment Station and the Division of Cereal Crops and Diseases, at Ames, Iowa, during the period from 1917 to about 1927. They were only slightly superior in yield to the then widely grown Richland and Iogold varieties. As a result, they were not named but were distributed under numbers to a limited extent in Iowa. They proved to be excellent parents for crossing with Bond.

Morota and Rainbow are sister selections from Green Russian developed and distributed by the North Dakota Agricultural Experiment Station. They are highly resistant to most races of stem rust and have moderate resistance to certain races of crown rust.

SOME DISTINGUISHING CHARACTERISTICS

A few characters not listed in table 1 may be useful in the identification of the varieties. In the field, Benton and Advance have a collar of short fine hairs on the lower side of the upper culm node, with the hairs lying parallel with the culm. As a rule Benton and Advance can be distinguished from Clinton and Mohawk by this character. The Bonham, Cherokee, Advance, and Nemaha varieties produce a reddish-yellow grain that is rather distinct from the yellow grain of Clinton and Mohawk. Seed analysts have recognized this difference and refer to the former varieties as "pink" oats.

The Bonda, Zephyr, and Mindo varieties usually have numerous awns, whereas most of the other spring varieties described in this circular have relatively few. Furthermore the awns of Bonda and Zephyr are twisted and geniculate and are frequently dark-colored on

TABLE 1.—*Varieties of oats resistant to Victoria blight*

Variety	C. I. ¹ and State No.	Cross: Date, originating station, and breeder ²	State stations testing and distributing, and date of release ³	C
Clinton-----	3971	Iowa D69 × Bond, 1932, Iowa, H. C. Murphy.	Iowa, Indiana, and Illinois, 1945.	E
Benton-----	3910	do-----	Indiana and Iowa, 1945	--
Cherokee-----	3846	do-----	Kansas, 1948-----	--
Bonham-----	4676	do-----	Michigan, 1948-----	--
Advance-----	3845	do-----	New York, 1949-----	--
Eaton-----	3908	Iogold × Bond, 1932, Iowa, H. C. Murphy.	Michigan, 1946-----	--
Mohawk-----	4327	Bond × Iowa D67, 1932, Iowa, H. C. Murphy.	New York, 1948-----	--
Shelby-----	4372	Anthony × Bond, 1932, Iowa, H. C. Murphy.	Iowa, 1949-----	--
Nemaha-----	4301	(Victoria-Richland) × (Morota-Bond), 1936, Iowa, H. C. Murphy.	Nebraska and Kansas, 1948	--
Bonda-----	4329 (Minn. 841)	Bond × Anthony, 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1946-----	--
Zephyr-----	4800 (Minn. 861)	do-----	Minnesota, 1949-----	--
Mindo-----	4328 (Minn. 852)	Bond × [(Minota-White Russian) × Black Mesdag], 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1946-----	--
Andrew-----	4170 (Minn. 865)	Bond × Rainbow, 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1949-----	--
Camellia-----	4079 (La. 629)	Bond × Alber, 1932, Virginia, T. R. Stanton.	Louisiana, 1942-----	H
Florida 167-----	4320	Bond × Fulghum, 1935, Florida, J. P. Camp.	Florida, 1943-----	--

¹ C. I. refers to accession number of the Division of Cereal Crops and Diseases.

² In the case of a few varieties, other breeders who have made further improvement or reselection are: Benton—R. M. Caldwell and associates; Bonham and Eaton—E. associates; and Camellia—John Gray and H. C. Murphy.

Uromyces victoriae) originating from crosses on Bond developed c^{as}
 NORTHERN SPRING OATS ^{ish}

Disease reaction other than to Victoria blight			Maturity
(leaf) rust ⁴	Stem rust	Smuts	
Highly resistant.	Resistant to all common races.	Resistant to some northern races of both smuts.	Early to mid-low.
do	do	do	do
do	do	do	Early, red (ivory).
do	do	do	Early to mid-dish yellow.
do	do	do	do
do	Resistant to all common races except 8 and 10.	do	Early to mid-lowish white.
do	Resistant to all common races.	do	Early to mid-low.
do	do	Resistant to nearly all races of the two smuts.	Early to mid-dish yellow.
do	do	do	Early, red (ivory).
do	do	Resistant to many races of both smuts.	Early to mid-lowish white.
do	do	do	Midseason, ch-to white.
do	do	do	Very early white.
do	Resistant to all common races, except 8 and 10.	do	Early, yellow.

SOUTHERN RED OATS

Highly resistant.	Susceptible to all races.	Resistant to many races of both smuts.	Midseason, distinct).
do	do	do	Very early (able).

³ Many State and Federal agricultural experiment stations had a part in determining the relative productiveness and adaptability of these selections. Down and Up had a part in determining the relative productiveness and adaptability of these selections.

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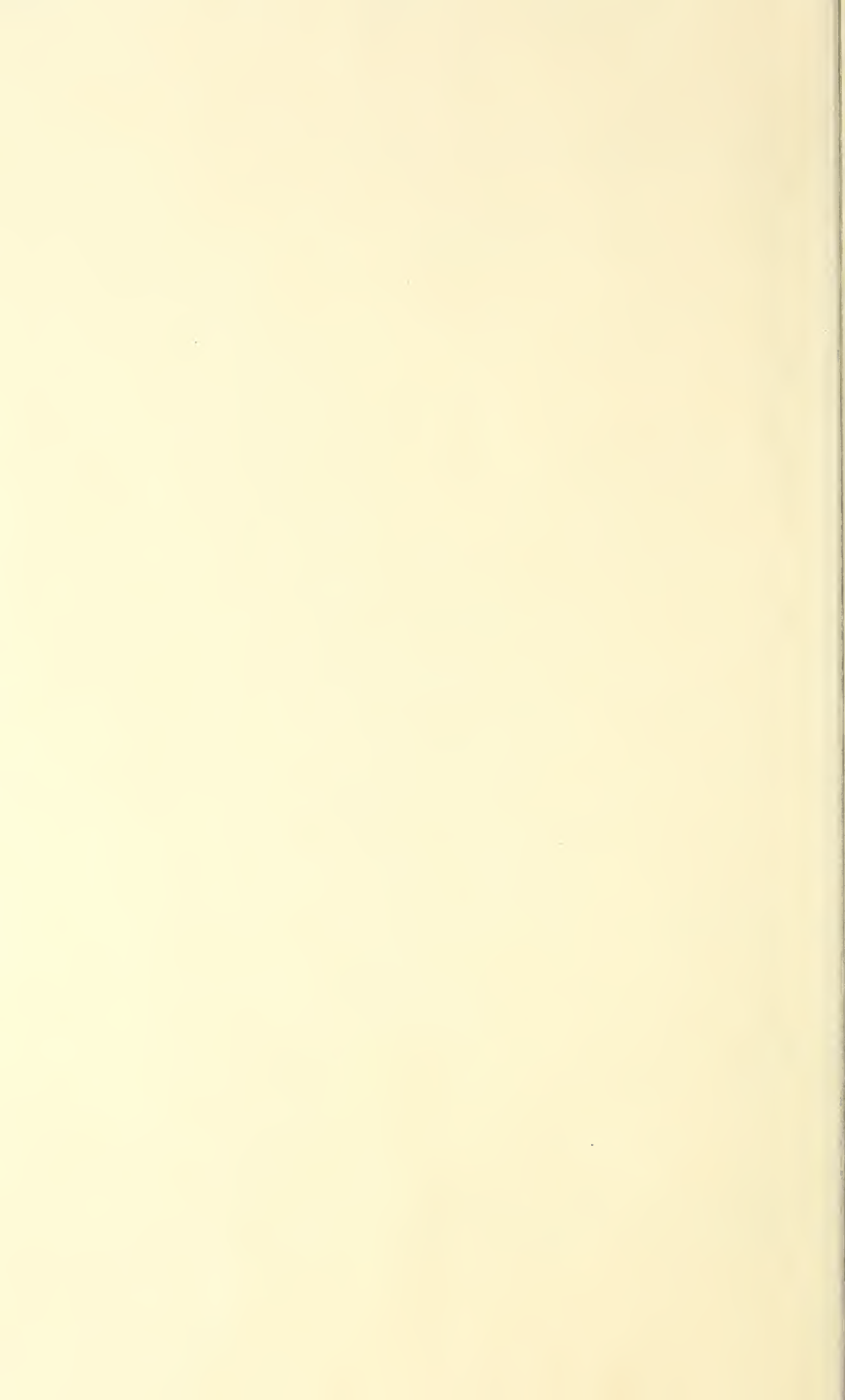


TABLE 1.—Varieties of oats resistant to Victoria blight (*Helminthosporium victoriae*) originating from crosses on Bond developed cooperatively by State agricultural experiment stations and the United States Department of Agriculture

NORTHERN SPRING OATS

Variety	C. I. ¹ and State No.	Cross Date, originating station, and breeder ²	State stations testing and distributing, and date of release ³	Disease reaction other than to Victoria blight			Maturity and grain color	Usual range in plant height	Relative test weight and size of grain	Relative stiffness of straw	Awns	Basal hairs	Where recommended
				Crown (leaf) rust ⁴	Stem rust	Smuts							
Clinton	3971	Iowa 1969 × Bond, 1932, Iowa, H. C. Murphy.	Iowa, Indiana, and Illinois, 1945.	Highly resistant.	Resistant to all common races.	Resistant to some northern races of both smuts.	Early to midseason, yellow.	Inches 32 to 38	Very heavy, short to mid-long, midplump, small to mid-sized.	Very stiff	Few or absent	Few or absent	North Central and Northeastern States (apparently widely adapted).
Benton	3910	do	Indiana and Iowa, 1945	do	do	do	do	36 to 42	do	Stiff	Few to common, non-twisted to twisted, subgeniculate.	do	North Central States.
Cherokee	3846	do	Kansas, 1948	do	do	do	Early, reddish yellow (ivory).	30 to 36	Very heavy, short, plump, mid-sized.	do	Rare	do	Kansas.
Bonham	4676	do	Michigan, 1948	do	do	do	Early to midseason, reddish yellow (ivory).	32 to 38	do	do	Few or absent	do	Upper Peninsula of Michigan.
Advance	3845	do	New York, 1949	do	do	do	do	38 to 44	Very heavy, short to mid-long, plump, mid-sized.	do	do	do	New York.
Eaton	3908	Iogold × Bond, 1932, Iowa, H. C. Murphy.	Michigan, 1946	do	Resistant to all common races except 8 and 10.	do	Early to midseason, yellowish white (grayish).	32 to 38	Very heavy, short to mid-long, midplump, small to mid-sized.	do	Few to common, non-twisted to twisted, subgeniculate.	do	Lower Peninsula of Michigan.
Mohawk	4327	Bond × Iowa D67, 1932, Iowa, H. C. Murphy.	New York, 1948	do	Resistant to all common races.	do	Early to midseason, yellow.	32 to 38	do	do	Few or absent	do	New York.
Shelby	4372	Anthony × Bond, 1932, Iowa, H. C. Murphy.	Iowa, 1919	do	do	Resistant to nearly all races of the two smuts.	Early to midseason, white.	38 to 44	Very heavy, short to mid-long, plump, mid-sized	Medium stiff	do	do	Iowa.
Nemaha	4301	(Victoria-Richland) × (Morota-Bond), 1936, Iowa, H. C. Murphy.	Nebraska and Kansas, 1948	do	do	do	Early, reddish yellow (ivory).	30 to 36	Very heavy, short, plump, mid-sized.	Stiff	do	do	Nebraska and Kansas.
Bonda	4329 (Minn. 841)	Bond × Anthony, 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1946	do	do	Resistant to many races of both smuts.	Early to midseason, yellowish white to white.	36 to 42	Very heavy, midlong, plump, large.	do	Numerous, twisted, geniculate, dark-colored on lower parts.	do	Minnesota and Iowa.
Zephyr	4800 (Minn. 861)	do	Minnesota, 1949	do	do	do	Midseason, grayish white to white.	36 to 42	do	Medium stiff	do	do	Minnesota.
Almdo	4328 (Minn. 852)	Bond × [(Minota-White Russian) × Black Mesdag], 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1946	do	do	do	Very early, yellowish white.	30 to 36	Very heavy, midlong, slender, small to mid-sized.	do	Common, nontwisted to twisted, geniculate.	do	Minnesota and Iowa.
Andrew	4170 (Minn. 865)	Bond × Rainbow, 1931, Minnesota, H. K. Hayes, M. B. Moore, and associates.	Minnesota, 1919	do	Resistant to all common races, except 8 and 10.	do	Early, yellow.	34 to 40	Very heavy, midlong, slender, small to mid-sized.	do	Rare	do	Minnesota.

SOUTHERN RED OATS

Camellia	4079 (La. 629)	Bond × Alber, 1932, Virginia, T. R. Stanton.	Louisiana, 1942	Highly resistant.	Susceptible to all races	Resistant to many races of both smuts.	Midseason, red (rather distinct).	32 to 38	Medium heavy, midlong, plump, large.	Stiff	Numerous, non-twisted.	Numerous, mid-long.	Southern Louisiana.
Florida 167	4320	Bond × Fulghum, 1935, Florida, J. F. Camp.	Florida, 1943	do	do	do	Very early, red (variable).	32 to 38	Medium heavy, midlong, midplump, mid-sized.	Medium stiff	do	do	Florida.

¹ C. I. refers to accession number of the Division of Cereal Crops and Diseases.

² In the case of a few varieties, other breeders who have made further improvement by selection or reselection are: Benton—R. M. Caldwell and associates; Bonham and Eaton—E. E. Down and associates; and Camellia—John Gray and H. C. Murphy.

³ Many State and Federal agricultural experiment stations and workers connected with them had a part in determining the relative productiveness and adaptation of these new varieties by growing them in uniform disease, yield, and other nurseries.

⁴ Except races 45, 57, and similar races, these less prevalent races of crown rust, although a potential menace, may not become destructive, owing to their late appearance in the crop season. Marion, a productive variety, derived from a Markton-Rainbow cross, is moderately resistant to these races, but highly resistant to Victoria blight.

vid

Clinton^{ds}

Benton--

Cherok^{di}

Bonhar^{ds}
w

Advan^e--

Eaton^{ds}
ita

Mohaw^{ds}

Shelby^{se}

Nemah^{di}

Bonda^{ds}
ita

Zephyr^{gr}

Mindo^l

Andrew^w

Camell^r

Florida

¹ Cinc
² Eio
or rese
associa

the lower part. Bonda also can be usually differentiated by its lemmas (grains), which are somewhat concave in the region of the awn, a character that was used to identify the now almost obsolete Swedish Select variety.

Camellia can be readily recognized by its rather distinct red, short, plump grains, or kernels. The spikelets separate from their pedicels (stems) by abscission (sterilis type), thus leaving a distinct basal cavity, or "sucker mouth," and the second florets (rachillae) separate from the first ones by fracture at the base of the rachilla segments as in typical Red Rustproof oats. Only the first floret (grain) of the spikelet usually is awned and bears numerous basal hairs. The awn, like that of typical Red Rustproof oats, is of the nontwisted type. Camellia, however, is still somewhat variable in grain and plant characters.

Florida 167 usually can be differentiated from Camellia in being a little earlier, in having slightly longer and more slender grains, and in being more of an intermediate type between red and common oats. It also is exceedingly variable.

SOURCES OF SEED

Clinton oats¹ (C. I. 3971), the first variety originating from Bond crosses, were distributed simultaneously in Iowa, Indiana, and Illinois in 1945 in sufficient quantity to be available to meet all demands for 1949. Iowa, Indiana, and Illinois have enough Clinton to sow their acreage and have enough to share with other States. Considerable quantities of Clinton also were produced in Ohio, Minnesota, North Dakota, and South Dakota in 1947. Clinton, likewise, has spread into Pennsylvania, New York, and the New England States, where some seed was produced in 1947. Considerable Clinton was grown in Michigan in 1948. Indiana should be well provided with seed of both Clinton and Benton. Although Benton was first distributed in the same year as Clinton, it has not become nearly so widely distributed or extensively grown. The somewhat shorter and stiffer straw of Clinton may have given it some advantage over Benton on rich soils where lodging is severe. On many of the light-colored soils of Indiana, however, the taller Benton is preferred, especially where sweetclover is seeded in the oats. The much greater initial distribution of seed of Clinton also gave it a big advantage over Benton.

Eaton was first distributed on a small scale in Michigan in 1946 but as yet has not become extensively grown and apparently has not spread much beyond the border of that State. Eaton seems to be especially well adapted to the Lower Peninsula of Michigan.

Mohawk (fig. 2), almost the counterpart of Clinton, is being distributed in New York and, together with Clinton, within the next few years probably will replace Vicland and virtually all the old rust-susceptible varieties, as Lenroc, Cornellian, and Ithacan. Bonham was distributed in Michigan in 1948 and is expected to increase rapidly, since it appears to be especially well adapted to the Upper Peninsula of that State. Advance will be distributed in New York in 1949, where a variety taller than Mohawk is desired for the dairy sections.

Shelby, Cherokee, and Nemaha are new, and seed is being increased as rapidly as possible for distribution in 1948 and 1949. Bonda and



FIGURE 2.—Mohawk (left), resistant to Victoria blight; Vicland (right), susceptible. (Courtesy of the New York State College of Agriculture.)

Mindo are being increased and distributed in Minnesota. Andrew and Zephyr, more recently named Minnesota varieties, also are being increased but will not be distributed for general farm production in that State until 1949. There was enough seed of Clinton, Bonda, and Mindo, however, to supply nearly all Minnesota growers in 1948.

Owing to the limited adaptation of Camellia and Florida 167, sufficient seed of these varieties should be available to meet all demands for seed in southern Louisiana and Florida, respectively.

Seed in limited quantities of all these new varieties for experimental purposes for 1948 and 1949 should be available on request from the stations from which they are being or will be distributed or from the respective State seed improvement associations.

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